

Success Story

DOE's "More Electric Truck" Could Revolutionize the Heavy-Duty Trucking Industry



Background

The engine compartment on today's heavy trucks is a hot and crowded place. Pumps, alternators, compressors, and other engine accessories all give off heat as they compete for space and for the energy they need from the engine. These accessories have little effect individually on engine power, but together – via belts and pulleys – they can rob a diesel engine's fuel efficiency. As fuel prices continue to rise, truck and fleet owners need ways to reduce their fuel use in order to stay profitable.

Now, thanks to a collaboration launched in 2000 between private industry and the U.S. Department of Energy (DOE), truck and fleet owners will have more fuel-saving options available to them. That's because a DOE project called the "More Electric Truck" has introduced new technology that takes a big load off truck engines by replacing mechanically driven accessories with electrically powered accessories. More Electric Trucks use less fuel, are more reliable, and require less maintenance.

The Technology

The DOE More Electric Truck concept incorporates accessories powered by a generator located inside the flywheel housing, which also serves as the starter motor. Researchers converted the

following accessories to electrical power on this research demonstration vehicle: the heating, ventilating, and air-conditioning (HVAC), brake air compressor, and oil and water pumps. Once they are validated, these and future electrically driven components will become commercially available to the trucking industry.

The More Electric Truck features an electrically driven HVAC module and a high-efficiency 30 kW switched reluctance (SR) generator. The HVAC module incorporates scroll technology that previously was available only on stationary HVAC units. Other features include an integrated auxiliary power unit (APU) and a "shore power" feature that permits the truck to plug in like a recreational vehicle at a campground. Shore power is available at select truck stop demonstration sites in the U.S., where drivers don't have to idle their big diesels to stay comfortable and to keep their engines warm. The new More Electric Truck accessories are not just add-on pieces of hardware, but are part of a highly integrated system specifically designed to meet the needs of the truck industry while minimizing weight and costs.



The prototype More Electric Truck

The DOE More Electric Truck's new HVAC system combines everything into one preassembled, precharged, and pretested module that eliminates up to 65 parts. Modular, swappable, electrically driven accessories such as this improve vehicle serviceability, which contributes to lower maintenance costs. They are also more reliable than mechanical components.

The new HVAC unit replaces the two separate heating and air-conditioning units used today on most trucks with sleeper cabs (one in the dashboard and one under the sleeper cab bunk).

When used with the integrated idling reduction features, the HVAC provides truck drivers with a more comfortable and quieter sleeping environment that enhances their comfort and job satisfaction.



Truckers typically idle for six hours or more during rest periods and while waiting at delivery depots, to keep the engine warm, stay comfortable, and power electrical equipment. Estimated savings from full implementation of the More Electric Truck's technology advances include:

- 2% On-Road Fuel Savings
- 6% Fuel Savings during Idling
- **8% Total Fuel Savings**

The reduction in engine idling alone could save up to 838 million gallons of diesel fuel every year and annually reduce engine emissions equal to that produced by 15.5 million cars. Argonne National Laboratory researchers have shown that eliminating overnight idling would save more than \$2,000 a year per truck in fuel and engine maintenance costs, which would put the payback period for the added investment in a More Electric truck at about 18 months. Argonne's work also shows that trucks idling overnight put an estimated 7.6 million tons of carbon dioxide, 140,000 tons of nitrogen oxides, and 2,400 tons of carbon monoxide into our atmosphere.

Commercialization

Launched in 2000, the More Electric Truck program is a \$4.8 million collaborative effort between DOE, Caterpillar Inc., Kenworth Truck Company, Emerson Electric, and Engineered Machine Products (EMP). Each partner brought core competencies to the project: Caterpillar provided

engine technology, mechanical design, electronics, controls and overall systems integration; Kenworth supplied truck expertise and testing capabilities; Emerson brought its electric motor and power electronics knowledge to the program; and EMP developed the new electrically driven water and oil pumps for the project.

Several More Electric Trucks built on International 9200 chassis equipped with Cat C13 engines began a 12-month field validation in Fall 2004. Once the More Electric Truck technologies achieve their designated performance targets, they will be available to original equipment manufacturers (OEMs) for licensing, something that should happen around mid-decade. From there, the technologies will become available to the marketplace as options for fleets and truck owners to consider as they purchase new trucks. Judging from the industry's response to the prototype More Electric Trucks shown at recent industry events, demand for the products should be very high.

Benefits

- Improves fuel efficiency by as much as 8%
- Reduces vehicle maintenance costs
- Increases vehicle maintenance intervals and serviceability
- Contributes to increased profitability
- Adds to truck driver comfort while driving and resting
- Eliminates harmful exhaust emissions produced during idling periods

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